PU030310

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
25 January 2001 (25.01.2001)

PCT

(10) International Publication Number
WO 01/06775 A1

(51) International Patent Classification[7]: H04N 5/50

(21) International Application Number: PCT/US00/19059

(22) International Filing Date: 13 July 2000 (13.07.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/144,336 16 July 1999 (16.07.1999) US

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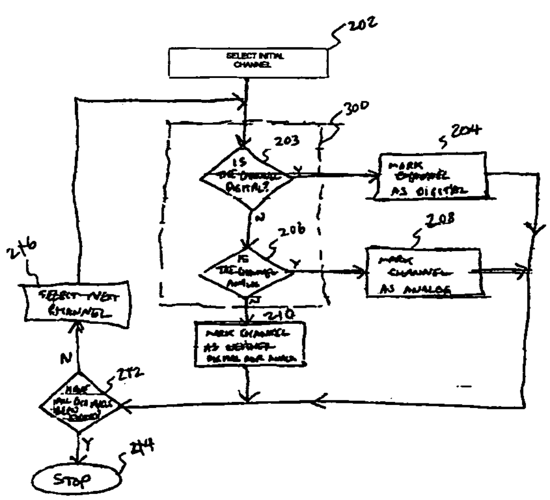
(81) **Designated States** *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) **Designated States** *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *With international search report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD AND APPARATUS FOR AUTOPROGRAMMING A TELEVISION RECEIVER



(57) Abstract: An apparatus for automatically programming information associated with a plurality of air and cable television channels. Upon receiving an autoprogramming signal, the apparatus detects analog and digital television signals from each channel to determine whether the associated air or cable channel is digital or analog. The apparatus stores information associated with the each channel into a memory unit. The results of all channels are displayed as a channel scanning list on an output device or monitor. A method for processing a plurality of air and cable television channels is also provided. The method selects a channel, receives an analog or digital signal associated with the selected channel, determines whether the channel is analog or digital, stores the result and repeats the steps until all channels have been selected. Additionally, a computer readable medium that stores a software program is provided. This program, when executed by a computer, causes the computer to perform the method embodied in the invention.

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METHOD AND APPARATUS FOR AUTOPROGAMMING A TELEVISION RECEIVER

FIELD OF THE INVENTION

The invention generally relates to television systems. More particularly, the invention relates to a method and apparatus for autoprogramming analog and digital television signal information associated with broadcast and cable channels.

DESCRIPTION OF THE PRIOR ART

Television receivers use channel autoprogramming algorithms and systems for automatically detecting active television channels and indicating these channels in a scanning list. The channels may comprise broadcast or air channels for transmitting radio frequency (RF) signals to the receiver via an antenna. Alternatively, the channels may comprise cable channels for transmitting RF signals to the receiver via a cable network.

The current autoprogramming algorithms and systems are limited to processing analog television channels. One such autoprogramming algorithm and system is described in U.S. Patent No. 4,776,038, issued to Testin et al. on October 4, 1988. Recent advances and increased use of digital television systems have created a need for autoprogramming digital television channels. However, the analog television receivers cannot autoprogram the signals associated with the digital television channels. As such, separate systems are typically required for detecting and indicating the respective analog and digital television channels.

Therefore, there is a need for a method and apparatus for extending the autoprogramming algorithms and systems to incorporate digital television channels.

SUMMARY OF THE INVENTION

The invention overcomes the disadvantages of the prior art by providing a method and apparatus for extending the autoprogramming algorithms and systems to incorporate digital television channels. Specifically, the apparatus

comprises a tuner, a digital signal converter, an analog signal converter, a video processor, a microprocessor and a memory unit. The tuner converts a radio frequency (RF) signal into an intermediate frequency (IF) signal. The analog signal converter demodulates the IF signal from the tuner into a baseband analog signal and generates tuning and video synchronization signals. The digital signal converter downconverts the IF signal into a near baseband signal, demodulates the near baseband signal into a baseband digital signal, and generates synchronization and error correction signals. The video processor further processes video and audio components of the respective baseband analog and digital signals for display on an output device. The memory unit stores the autoprogramming algorithm and information associated with the analog and digital television channels.

The microprocessor executes the autoprogramming algorithm or program that is stored in the memory unit. The microprocessor controls the tuner, receives signals from the analog and digital signal converters, determines the type of channel based on the received signals, stores the result in the memory unit and repeats the procedure for each available channel until all channels are processed.

A method for processing a plurality of television channels is also provided. Specifically, the method comprises the steps of selecting a channel from a plurality of channels, receiving a signal associated with the selected channel, and determining whether the selected channel is digital or analog, storing information associated with the selected channel into a memory unit. These steps are repeated for each of the plurality of channels. Additionally, a computer readable medium that stores a software program is provided. This program, when executed by a computer, causes the computer to perform the method embodied in the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The teachings of the present invention can be readily understood by considering the following detailed description in conjunction with the accompanying drawings, in which:

FIG. 1 depicts a block diagram of a television receiver capable of receiving analog and digital signals;

FIG. 2 depicts a flow chart of a method for scanning various channels;

FIG. 3 depicts a flow chart of a method for detecting whether a channel is analog, digital or neither; and

FIG. 4 depicts a flow chart of a method for detecting a whether a channel is digital.

To facilitate understanding, identical reference numerals have been used, where possible, to designate identical elements that are common to the figures.

DETAILED DESCRIPTION

FIG. 1 depicts a block diagram of a television receiver 100 capable of receiving analog and digital television signals. The receiver 100 comprises a tuner 102, a digital demodulator 104, a forward error correction (FEC) module 106, a digital signal processor 108, an analog demodulator 110, an analog signal processor 112, a microprocessor 114, a memory unit 116 and a video processor 118. Additionally, the receiver 100 interfaces with a signal interface 120, an input device 122 and an output device 124.

The tuner 102 receives modulated radio frequency (RF) signals via a signal interface 120. Different signal interfaces 120 are required depending on whether the received RF signals are associated with air channels (also known as broadcast channels) or cable channels. If the tuner 102 receives television signals from air channels, then the signal interface 120 comprises an antenna. If the tuner 102 receives television signals from cable channels, then the signal interface 120 comprises a cable network connection. The signal interface 120 may receive various signal types from various sources.

The RF signals associated with air and cable channels are analog and digital television signals. The analog television signal may comprise a conventional National Television Standard Committee (NTSC) modulated signal within the United States. The digital television signal may comprise a Vestigial Sideband (VSB) modulated signal in compliance with the Advanced Television Systems Committee (ATSC) standard A/53.

The tuner 102 converts or heterodynes the received RF signal into an intermediate frequency (IF) signal. Once the microprocessor 114 receives an autoprogramming command from the input device 122, the microprocessor 114 initiates a search of the active channels. For each channel, the microprocessor 114 sends a voltage signal to the tuner 102 that corresponds to the required local oscillator (LO) frequency. After the microprocessor 114 determines the appropriate LO frequency for a selected channel, the tuner 102 converts the RF signal into an IF signal. In the United States, the IF of the video carrier is 45.75 MHz for the analog television signal and 44 MHz for the digital television signal.

After the tuner 102 converts the received television signal into an IF signal, the television receiver 100 processes the digital and analog IF television signals. Specifically, the television receiver comprises a digital signal converter 126 to process the IF digital television signal and an analog signal converter 128 to process the IF analog television signal. The digital signal converter 126 comprises the digital demodulator 104, forward error correction module 106 and the digital signal processor 108. The analog signal converter comprises an analog demodulator 110 and the analog signal processor 112. The video processor 118 further processes the video and audio components of the respective analog and digital television signals into a suitable format for display on the output device 124.

The digital demodulator 104 downconverts the IF digital television signal into a near baseband (NBB) signal, performs carrier lock on the NBB signal to convert the NBB signal to a baseband digital symbol stream, and performs symbol timing on this symbol stream. To perform these functions, the digital demodulator 104 includes a frequency downconverting stage, a carrier recovery loop and a symbol timing recovery loop. The frequency downcoverting stage receives the IF signal, centered at 44 MHz, from the tuner 102 and downconverts the IF signal frequency to a NBB frequency, e.g., 5.38 MHz (or half the symbol rate of the digital data stream).

The carrier recovery loop generates a local oscillator (LO) signal that is matched or phase-locked to the carrier in the NBB signal. Once phase lock occurs, this loop generates a Carrier Lock signal to the microprocessor 114. The

carrier recovery loop then mixes the LO signal with the NBB signal for removing the carrier in the NBB signal and converting the NBB signal to a baseband data stream.

After sending the Carrier Lock signal, the symbol timing recovery loop matches or phase-locks the baseband data stream for recovering a data symbol stream from the baseband data stream. The data stream comprises a sequence of data fields. Each data field includes one field synchronization (sync) segment and 312 data segments. Each data segment includes 4 segment sync symbols and 828 symbols for payload and error check. These 4 segment sync symbols represents a segment sync word. If the digital television signal is an 8-VSB signal, then the payload symbols include a 188-byte MPEG-2 data packet and the error check symbols include 20 parity bytes.

As each sync segment includes one segment sync word, the segment sync words are periodic within the data stream, illustratively, at 10.76 Msymbols/sec. In the case of an 8-VSB digital television signal, the segment sync word includes a reference pattern of 1, −1, −1, 1. Once the digital demodulator correlates the segment sync word to a predetermined level of confidence, the digital demodulator 104 sends a Segment Lock signal to the microprocessor 114.

After the digital demodulator 104 achieves segment lock, the forward error correction (FEC) module 106 detects and corrects errors in the demodulated digital signal. To compensate the effects of changing conditions and disturbances in the signal transmission channel, the FEC module 106 comprises an adaptive equalizer for removing the channel distortions or performing channel equalization. However, the adaptive equalizer may introduce a variable delay to the data stream. As such, the data stream from the equalizer may no longer be aligned with the segment synchronization signals. The FEC module 106 must realign the data stream to the segment sync signals for enabling forward error correction of the data streams. When this occurs, the FEC module 106 provides a FEC Lock signal to the microprocessor 114.

Additionally, the FEC module 106 comprises an error correction module such as a Reed Solomon decoder. The Reed Solomon decoder uses the 20 parity

bytes in each segment for correcting the 187 data bytes in each data packet. The Reed Solomon decoder may correct up to 10 erroneous bytes per packet. As such, the packet contains uncorrectable errors if the packet contains more than 10 erroneous bytes.

The number of uncorrectable packet errors per second is the Reed Solomon Error Rate. If the error rate is sufficiently low, then the FEC module 106 sends a Reed Solomon Error Rate signal to the microprocessor 114. However, if this error rate is too high, then the digital signal processor 108 may not properly decode the associated video and audio information in the data stream.

The digital signal processor 108 separates the baseband digital signal or data stream into video and audio component signals. The video processor 118 further processes the component signals into a suitable format for display on the output device 124. The output device 124 is television monitor or some other display device.

The analog demodulator 110 demodulates the analog IF modulated signal into a baseband signal comprising video and audio components. Additionally, the analog demodulator 110 comprises an automatic fine tuning (AFT) circuit for determining whether the video component of the IF signal deviates from the nominal IF frequency of 45.75 MHz. If the frequency of the video component is above 45.75 MHz, then the AFT circuit decides that the video component frequency is too high and provides a "00" value to the microprocessor 114. If the frequency of the video component is below 45.75 MHz, the AFT circuit decides that the video component frequency value is too low and provides a "11" value to the microprocessor 114. Other possible values of the AFT circuit are also contemplated within the scope of the invention.

The analog signal processor 112 separates the baseband analog television signal into video and audio component signals. As with the corresponding video and audio signals of the digital television signal, the video processor 118 further processes the component analog television audio and video signals for display on the output device 124. Additionally, the analog signal processor 112 derives a composite synchronization ("SYNC") signal from the video signal. Such a

composite SYNC signal typically comprises horizontal and vertical video synchronization signals. The composite SYNC signal is coupled to the microprocessor 114.

The microprocessor 114 coordinates the channel detection and autoprogramming functions associated with the television receiver 100. Initially, the microprocessor 114 receives an autoprogramming command from the input device 122 such as a remote control, keyboard or other devices for entering data. For example, the input device 122 may direct the microprocessor 114 to search all of the active air and/or cable channels. As the air and cable channels are used for transmitting analog and digital television signals, the microprocessor 114 detects the type of television signal for each channel searched. Once the microprocessor 114 detects the type of television signal transmitted over each air and/or cable channel, the microprocessor 114 stores or loads the channel information in the memory unit 116. The microprocessor 114 indicates whether a given air or cable channel is analog or digital depending on the type of television signal detected. The channel information is retrieved from the memory unit 116 and shown on the output device 124 or display.

Additionally, the microprocessor 114 executes software programs to properly detect whether the channels associated with television signals are analog, or digital. The software programs are stored in the memory unit 116 such as a read only memory (ROM). Upon executing the software programs, the microprocessor 114 utilizes signals from the digital demodulator 104, the FEC module 106, the analog demodulator 110 and the analog signal processor 112. These signals include Carrier Lock and Segment Lock signals from the digital demodulator 104 , and FEC Lock and Reed Solomon Error Rate signals from the FEC module 106.

The microprocessor 114 initially scans the channels as depicted in FIG. 2. For each channel that is receivable, the associated television signal is determined as being either analog or digital as further depicted in FIG. 3. Specifically, as depicted in FIG. 4, if the television signal is not digital, then the AFT signal from the analog demodulator 110 and the composite SYNC signal from the analog signal processor 112 are used to determine whether the television signal and

corresponding channel is analog. Each channel is marked as either analog or digital depending on the type of television signal. Finally, the channel information is automatically programmed into the memory unit 116, e.g., a random access memory (RAM) or an electrically erasable programmable read only memory (EEPROM).

The channel information is displayed on the output device 124 as a channel scanning list. As the information about the channels is stored in the memory unit 116 and displayed on the output device 124, the television receiver 100 does not need to determine whether the user selected channel is analog or digital. As such, once a channel is selected, the time required for tuning that channel is reduced.

The present invention may also be implemented as a program product for use with a computer system, e.g., a television system. The program(s) of the program product defines functions that can be contained on a variety of signal/bearing media, which include, but are not limited to, (i) information permanently stored on non-writable storage media, (e.g., read-only memory devices within a computer such as CD-ROM disks readable by a CD-ROM drive); (ii) alterable information stored on writable storage media (e.g., floppy disks within a diskette drive or hard-disk drive); or (iii) information conveyed to a computer by a communications medium, such as through a computer or telephone network, including wireless communications. Such signal-bearing media, when carrying computer-readable instructions that direct the functions of the present invention, represent additional embodiments of the present invention.

FIG. 2 depicts a flow chart of a method 200 for detecting a plurality of channels. The microprocessor 114 executes a software program (that embodies this method 200) to scan or select channels. After detecting all of the selected channels, the microprocessor 114 stores or loads the information associated with the channels into the memory unit 116.

The method 200 initially selects an initial channel at step 202. The method 200 proceeds to at step 203, for determining whether the present channel is a digital channel. Step 203 is embodied in a method 400 as further described in FIG. 4 below. If the channel is digital, the method 200 proceeds to

step 204, where the present channel is marked as a digital channel. If the channel is not digital, then the method 200 proceeds to step 206 for determining whether the present channel is an analog channel. If the selected channel is analog, then the method 200 proceeds to step 208, where the present channel is marked as an analog channel. Otherwise, the method 200 proceeds to step 210, where the present channel is marked as neither a digital channel nor an analog channel. The combination of steps 203 and 206 is embodied in a method 300 as further described in FIG. 3 below. As such, method 300 determines whether the present channel is digital or analog.

After the method 200 marks the channel in respective steps 204, 208 and 210, the method 200 proceeds to determine whether all the channels have been selected or searched at step 312. If all the channels have been selected, the method 200 proceeds to step 214 and stops. If there are additional channels to select, the method 200 proceeds to select the next available channel at step 216 and repeats itself (method 200) until all channels have been selected.

As previously mentioned, the combination of steps 203 and 206 is embodied within a method 300. FIG. 3 depicts a flow chart of a method 300 for detecting whether the channel is analog, digital, or neither analog nor digital. The method 300 processes analog and digital signals associated with the selected air and cable channels. The method 300 is implemented each time a new channel is selected or scanned.

The channel detection method 300 starts at step 302. The method 300 proceeds to step 304, where the LO frequency is selected such that the tuner 102 converts the incoming RF signal to an intermediate frequency (IF) equivalent to a nominal frequency value, i.e., 44 MHz for a digital television signal. At step 306, the method 300 presumes that the television receiver 100 receives a digital television signal. The method 300 proceeds to step 307 to determine whether the selected or scanned channel is digital. Step 307 is embodied in the method 400 of FIG. 4. If the channel is digital, then the method 300 proceeds to step 204, where the channel is detected and marked as a digital channel. If the channel is not digital, then the method 300 proceeds to step 308, where the

method 300 presumes that the television receiver 100 receives an analog television signal.

The method 300 proceeds to step 310, where the frequency of the LO is set such that the tuner 102 converts the incoming RF signal to an IF that is 0.1875 MHz above the nominal IF frequency. The nominal IF is 45.75 MHz for the video carrier portion of the analog television signal in the United States. The 0.1875 MHz deviation represents three 62.5 kHz steps, where each 62.5 kHz step or increment represents the resolution of the phase lock loop (PLL) integrated circuit (IC) in the tuner 102. This 0.1875 MHz deviation represents a far enough deviation from the nominal IF frequency, such that the AFT circuit may determine whether the converted IF frequency is too high or too low. At step 312, the method 300 determines whether the automatic fine tuning (AFT) value is 00. If the AFT value equals 00, then the method 300 proceeds to step 314. If the AFT value is not 00, then the method 300 proceeds to step 316.

At step 314, the frequency of the LO is set such that the tuner 102 converts the incoming RF signal to an IF that is 0.1875 MHz below the nominal frequency. The method 300 proceeds to step 318 for determining whether the AFT value equals 11. If the AFT equals 11, then the method 300 proceeds to step 320. In this case, the video component of the IF analog television signal is properly centered about the nominal IF of 45.75 MHz. If the AFT does not equal 11, then the method 300 proceeds to step 316.

At step 320, the method 300 determines whether the microprocessor 114 detects the SYNC (synchronization) signal from the analog processor 112. If the microprocessor 114 detects the SYNC signal, then the method 300 proceeds to step 322. If the microprocessor 114 fails to detect the SYNC signal, then the method 300 proceeds to step 316.

At step 322, method 300 determines that the received television signal is analog. The method 300 proceeds to step 208, where the microprocessor 114 marks the detected channel as an analog channel and stores the result in the memory unit 116.

At step 316, the method 300 determines whether the detected channel is a cable channel or an air (broadcast) channel. If the detected channel is an air

channel, then the method 300 proceeds to step 210, where the microprocessor 114 marks the channel as neither an active analog or digital channel. This result is stored in the memory unit 116. If the detected channel is a cable channel, the method 300 proceeds to step 324. At step 324, the method 300 presumes that the television receiver 100 receives a digital television signal.

The signals associated with cable channels may have a harmonically related carrier (HRC) or an incrementally related carrier (IRC). The method 300 proceeds step 326, where the frequency of the LO is set such that the tuner 102 converts the incoming RF signal to an IF associated with the HRC frequency. The method 300 then proceeds to step 327 for determining whether the cable channel is digital. As with step 307, step 327 is embodied in method 400 of FIG. 4. If the cable channel is digital, then the method 300 proceeds to step 204, where the cable channel is detected and marked as a digital channel. If the cable channel is not digital, then the method 300 proceeds to step 328, where the method 300 presumes that the television receiver 100 receives an analog television signal associated with cable channels.

At step 330, the frequency of the LO is set such that the tuner 102 converts the incoming RF signal to an IF that is 0.1875 MHz above the HRC frequency. The method 300 proceeds to step 332, where the microprocessor 114 determines whether the automatic fine tuning (AFT) value equals 00. The AFT value is coupled to the microprocessor through the analog demodulator 110. If the AFT value equals 00, then the method 300 proceeds to step 334. If the AFT value is not 00, then the method 300 proceeds to step 336.

At step 334, the frequency of the LO is set such that the tuner 102 converts the incoming RF signal to an IF that is 0.1875 MHz below the HRC frequency. The method 300 proceeds to step 338, where the microprocessor 114 determines whether the AFT signal equals 11. If the AFT signal equals 11, then the method proceeds to step 340, where the method 300 determines whether the microprocessor 114 detects the SYNC (synchronization) signal from the analog processor 112. If the microprocessor 114 detects the SYNC signal, then the method 300 proceeds to step 322 and then to step 208 for detecting the cable channel as analog. If the microprocessor 114 fails to detect the SYNC

signal, then the method 300 proceeds to step 210, where the cable channel is detected as neither an analog or digital channel.

At step 336, the microprocessor 114 determines whether the selected cable channel is either channel 5 or 6. As the HRC and IRC frequencies are the same for all cable channels except cable channels 5 and 6, the method 300 determines whether a cable signal is located at IRC frequency for cable channels 5 or 6. If the selected cable channel is channel 5 or 6, then the method 300 proceeds to step 342. Otherwise, there is no need to locate any additional signals and the method 300 proceeds to step 210, where the cable channel is detected as neither an active analog nor digital channel.

At step 342, the method 300 presumes that the television receiver 100 receives a digital television signal. The method 300 proceeds step 344, where the frequency of the LO is set such that the tuner 102 converts the incoming RF signal to an IF associated with the IRC frequency. The method 300 then proceeds to step 345 for determining whether the cable channel is digital. As with steps 307 and 327, step 345 is embodied in method 400 of FIG. 4. If the cable channel is digital, then the method 300 proceeds to step 204, where the cable channel is detected and marked as a digital channel. If the cable channel is not digital, then the method 300 proceeds to step 346, where the method 300 presumes that the television receiver 100 receives an analog television signal associated with cable channels.

The method 300 proceeds to step 348, where the local oscillator frequency is set such that the tuner 102 converts the incoming RF signal to an IF that is 0.1875 MHz above the IRC frequency. At step 350, the microprocessor 114 determines whether the automatic fine tuning (AFT) value equals 00. If the AFT value equals 00, then the method 300 proceeds to step 352. If the AFT value is not 00, then the method 300 proceeds to step 328.

At step 352, the frequency of the LO is set such that the tuner 102 converts the incoming RF signal to an IF that is 0.1875 MHz below the IRC frequency. The method 300 proceeds to step 354, where the microprocessor 114 determines whether the AFT signal equals 11. If the AFT signal equals 11, then the method 300 proceeds to step 340, where the method 300 determines

whether the microprocessor 114 detects the SYNC (synchronization) or video synchronization signal from the analog processor 112. If the microprocessor 114 detects the SYNC signal, then the method 300 proceeds to step 322 and then to step 208 for detecting the cable channel an active analog channel. If the microprocessor 114 fails to detect the SYNC signal, then the method 300 proceeds to step 210, where the cable channel is detected as neither an active analog or digital channel.

FIG. 4 depicts a flow chart of a method 400 for detecting a digital channel. The method 400 determines whether a channel, associated with a digital signal, is a digital channel. At step 402, the method 400 initializes a failure timer for two seconds. As such, the method 400 must detect the selected digital channel before the timer times out in two seconds. The timer minimizes the delay introduced by the digital channel detection method 400.

The method 400 proceeds to step 404, where the LO frequency is selected such that the tuner 102 converts the incoming RF signal to an intermediate frequency (IF) equivalent to a nominal frequency value, 44 MHz for a digital television signal. At step 406, the method 400 determines whether the microprocessor 114 received the Carrier Lock signal from the digital demodulator 114. If the microprocessor 114 received the Carrier Lock signal, the method 400 proceeds to step 408. If the microprocessor 114 fails to receive the Carrier Lock signal, the method 400 proceeds to step 410.

At step 410, the LO frequency is selected such that the tuner 102 converts the RF signal to an IF equal to 62.5 kHz above the nominal frequency. The 62.5 kHz increment represents the resolution of the phase lock loop (PLL) integrated circuit (IC) in the tuner 102. The method 400 proceeds to step 412, where the method 400 determines whether the microprocessor 114 received the Carrier Lock signal after changing the LO frequency. If the microprocessor 114 receives the Carrier Lock signal, then the method 400 proceeds to step 408. Otherwise, the method 400 proceeds to step 414, where the microprocessor 114 marks the detected channel as not digital (or not an active digital channel). At this point, the method 400 concludes and reenters the method 300.

At step 408, the method 400 initializes symbol timing of the digital baseband signal. The method 400 proceeds to step 416, where the method 400 determines whether the microprocessor 114 receives a Segment Lock signal from the digital demodulator 104. If the microprocessor 114 receives the Segment Lock signal, then the method 400 proceeds to step 418. If the microprocessor 114 fails to receive the Segment Lock signal, the method proceeds to step 414. As such, the channel is not an active digital channel if the microprocessor 114 fails to receive either a Carrier Lock or Segment Lock signal.

At step 416, the method 400 determines whether the microprocessor 114 receives the FEC Lock signal from the forward error correction (FEC) module 106. If the microprocessor 114 receives the FEC Lock signal, then the method 400 proceeds to step 420. If the microprocessor 114 fails to receive the FEC Lock signal, the method 400 proceeds to step 422.

At step 420, the method 400 determines whether the microprocessor 114 receives the Reed Solomon Error Rate signal from the FEC module 106. If the microprocessor 114 receives the Reed Solomon Error Rate signal, then the method proceeds to step 424. In this case, the microprocessor 114 detects the selected channel as digital and stores the result in the memory unit 116. As such, the channel is detected as an active digital channel if there is a carrier lock, a segment lock, a FEC lock and a sufficiently low Reed Solomon error rate before the timer expires. If the microprocessor 114 fails to receive the Reed Solomon Error Rate signal, the method 400 proceeds to step 422.

At step 422, the method 400 determines whether the timer, illustratively two seconds, is expired. If the timer is expired, then the method 400 proceeds to step 414, where the channel is not detected as digital. The method 400 then proceeds back to method 300. If the time is still active, then the method 400 proceeds to step 424.

At step 424, the method 400 rechecks whether the microprocessor 114 receives a Carrier Lock signal. If the Carrier Lock is present, then the method 400 proceeds to step 408, where symbol timing is reinitialized. If the Carrier Lock is not present, then the method 400 proceeds to step 404 for effectively reevaluating the digital signal.

The methods described herein are not limited to the values or signals illustratively shown. Although various embodiments which incorporate the teachings of the present invention have been shown and described in detail herein, those skilled in the art can readily devise many other varied embodiments that still incorporate these teachings.

What is claimed is:

1. A method for processing a plurality of channels, the method comprising the steps of:

selecting a channel from the plurality of channels;

receiving a signal associated with the selected channel;

determining whether the selected channel is digital;

determining whether the selected channel is analog;

storing information associated with the selected channel ; and

repeating said selecting, receiving, digital channel determining, analog channel determining and storing steps until each of the plurality of channels have been selected.

2. The method of claim 1 wherein the information associated with the selected channel is stored into a memory unit.

3. The method of claim 1 wherein said digital channel determining step further comprises the steps of:

determining that the received signal is a digital baseband signal;

receiving synchronization and error check signals from the received signal;

determining whether the generated synchronization and error check signals are proper for a digital television signal; and

marking the selected channel as digital if the synchronization and error check signals are proper.

4. The method of claim 3 wherein the synchronization signals comprise a Carrier Lock signal and a Segment Lock signal.

5. The method of claim 3 wherein the error check signals comprise a Forward Error Correction (FEC) signal and a Reed Solomon Error Rate signal.

6. The method of claim 1 wherein said analog channel determining step

further comprises the steps of:

determining that the received signal is an analog baseband signal;

determining whether a video carrier of the analog baseband signal is automatically fine tuned;

determining whether a video synchronization signal is detected;

marking the channel as analog if the video carrier is automatically fine tuned and the video synchronization signal is detected.

7. The method of claim 6 wherein said video synchronization is a composite SYNC signal having a vertical synchronization signal and a horizontal synchronization signal.

8. An apparatus for automatically programming information associated with a plurality of channels, the apparatus comprising:

a tuner for converting a radio frequency (RF) signal associated with each of the plurality of channels into an intermediate frequency (IF) signal;

a digital signal converter, coupled to said tuner, for demodulating the IF signal into a baseband digital signal and generating synchronization and error correction signals from the baseband digital signal;

an analog signal converter, coupled to said tuner, for demodulating the IF signal into a baseband analog signal and generating tuning and synchronization signals from the baseband analog signal;

a video processor, coupled to said digital and analog signal converters, for processing video and audio components of the baseband digital and analog signals to an output device;

a memory unit, for storing autoprogramming software and information associated with each of the plurality of channels; and

a microprocessor, coupled to said digital signal converter, said analog signal converter, said tuner and said memory unit, for controlling said tuner, receiving signals from said analog and digital signal converters, executing autoprogramming software, determining the type of channel for each of the plurality of channels and storing information about each of the plurality of

channels into said memory unit.

9. The apparatus of claim 8 wherein said digital signal converter comprises:

a digital demodulator for demodulating the IF signal into a digital baseband signal and generating synchronization signals;

a forward error correction (FEC) module, coupled to said digital demodulator, for generating error correction signals; and

a digital signal processor, coupled to said FEC module, for separating the digital baseband signal into video and audio components.

10. The apparatus of claim 8 wherein the analog signal converter comprises:

an analog demodulator for demodulating the IF signal into an analog baseband signal and generating tuning signals; and

an analog signal processor, coupled to said analog demodulator, for generating video synchronization signals and separating the analog baseband signal into video and audio components.

11. The apparatus of claim 8 wherein said microprocessor determines the type of channel by executing autoprogramming software stored in said memory unit.

12. The method of claim 8 wherein the synchronization signals comprise a Carrier Lock signal and a Segment Lock signal.

13. The method of claim 8 wherein the error correction signals comprise FEC Lock and Reed Solomon Error Rate signals.

14. A computer readable medium storing a software program that, when executed by a computer, causes the computer to perform a method comprising:

selecting a channel from the plurality of channels;

receiving a signal associated with the selected channel;

determining whether the selected channel is digital;

determining whether the selected channel is analog;

storing information associated with the selected channel ; and

repeating said selecting, receiving, digital channel determining, analog channel determining and storing steps until each of the plurality of channels have been selected.

15. The computer readable medium of claim 14 wherein said digital channel determining step further comprises the steps of:

determining that the received signal is a digital baseband signal;

receiving synchronization and error check signals from the received signal;

determining whether the generated synchronization and error check signals are proper for a digital television signal; and

marking the selected channel as digital if the synchronization and error check signals are proper.

16. The computer readable medium of claim 14 wherein said analog channel determining step further comprises the steps of:

determining that the received signal is an analog baseband signal;

determining whether a video carrier of the analog baseband signal is automatically fine tuned;

determining whether a video synchronization signal is detected;

marking the channel as analog if the video carrier is automatically fine tuned and the video synchronization signal is detected.

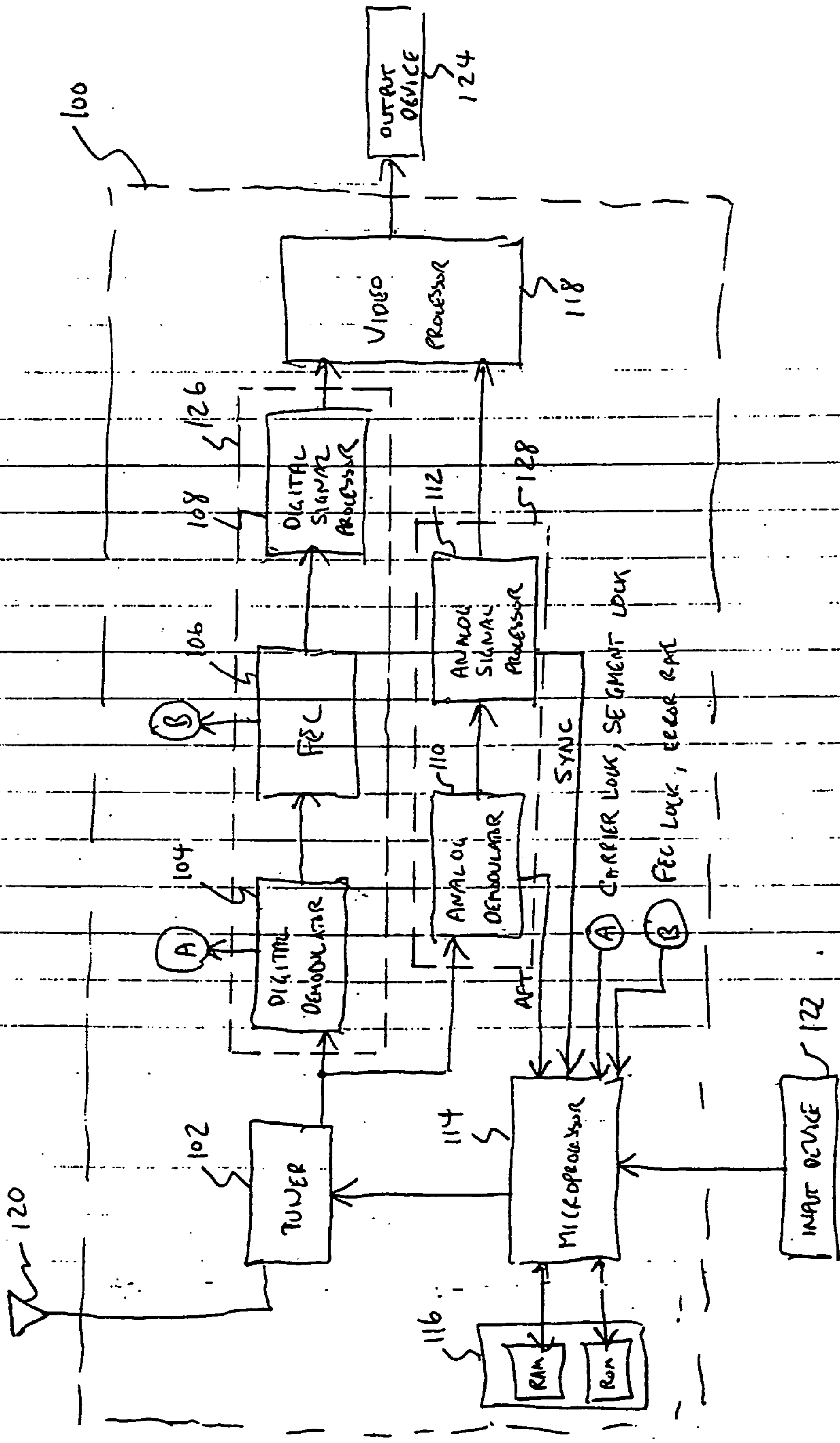

100
120
TUNER
102
DIGITAL DEMODULATOR
104
A
FEC
106
B
DIGITAL SIGNAL PROCESSOR
108
126
ANALOG DEMODULATOR
110
ANALOG SIGNAL PROCESSOR
112
128
VIDEO PROCESSOR
118
OUTPUT DEVICE
124
AFT
SYNC
CARRIER LOCK, SEGMENT LOCK
FEC LOCK, ERROR RATE
MICROPROCESSOR
114
RAM
ROM
116
INPUT DEVICE
122

FIG 1

FIG 2

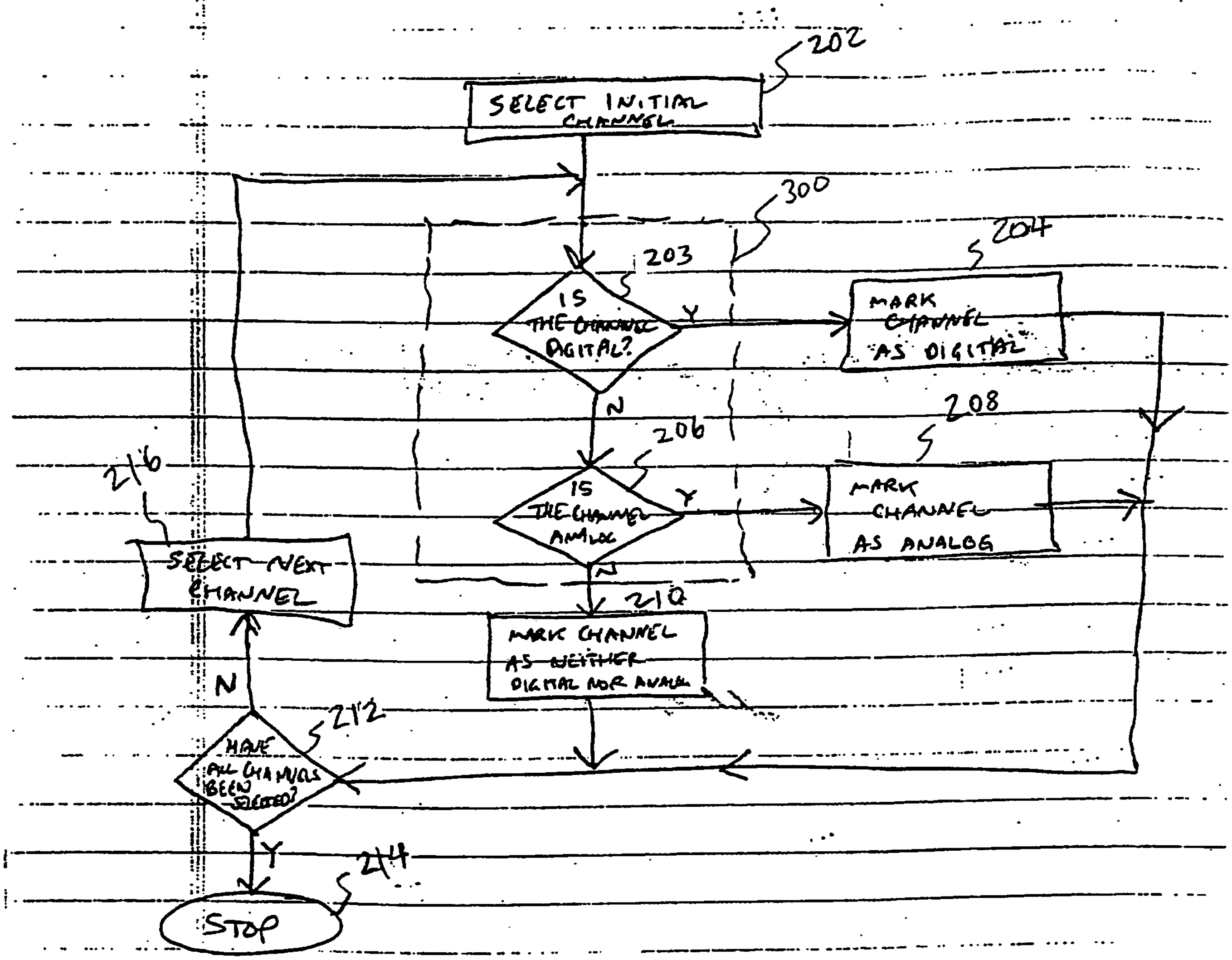

202
SELECT INITIAL CHANNEL
300
203
IS THE CHANNEL DIGITAL?
Y
N
204
MARK CHANNEL AS DIGITAL
206
IS THE CHANNEL ANALOG
Y
N
208
MARK CHANNEL AS ANALOG
210
MARK CHANNEL AS NEITHER DIGITAL NOR ANALOG
216
SELECT NEXT CHANNEL
N
212
HAVE ALL CHANNELS BEEN SELECTED?
Y
214
STOP

FIG. 3

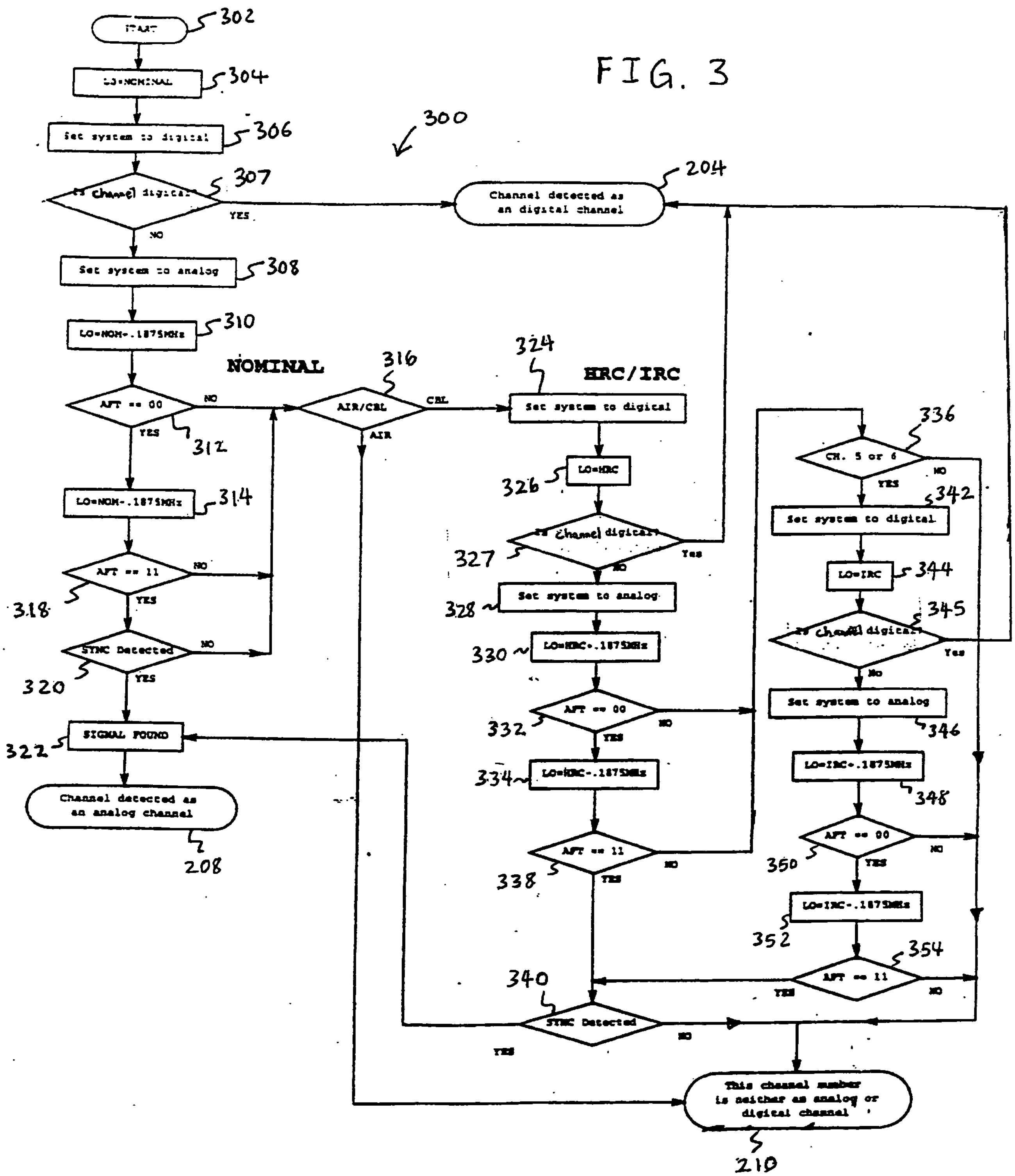
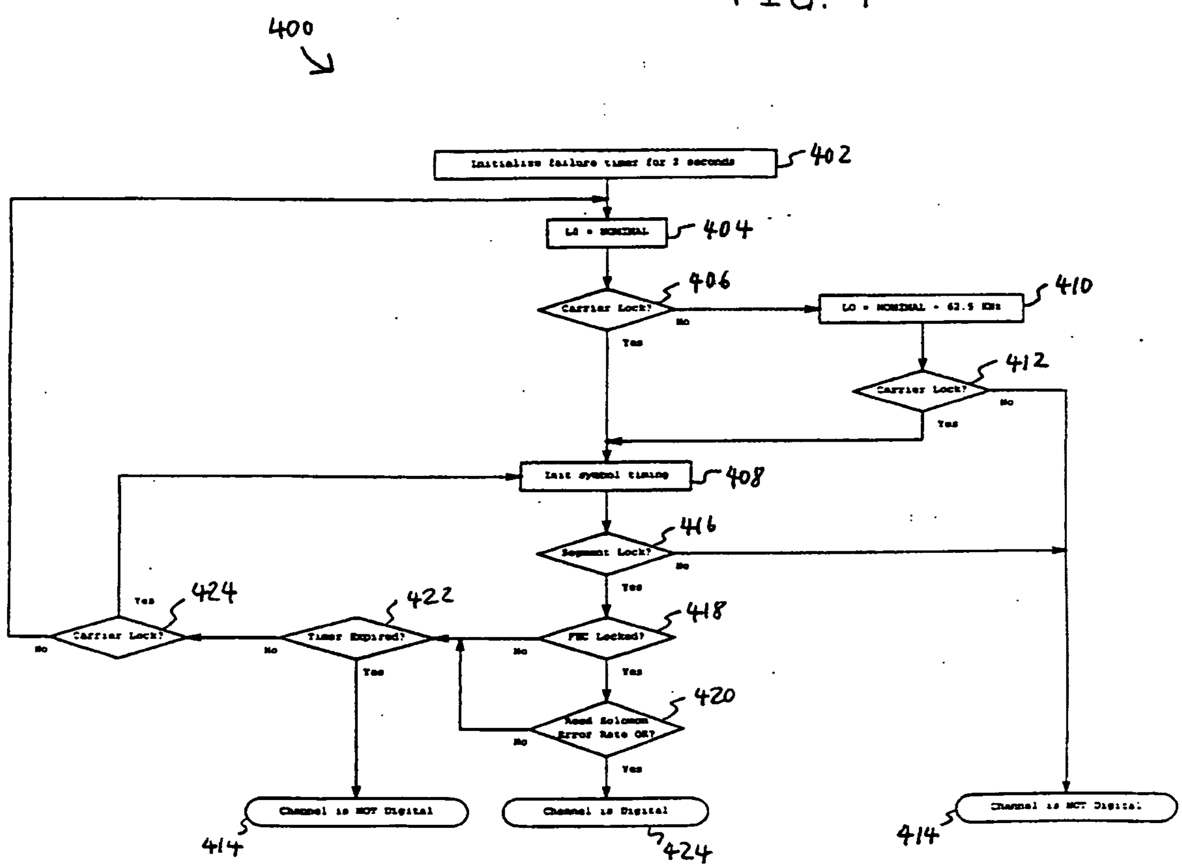

START
302
LO=NOMINAL
304
Set system to digital
306
Is channel digital?
307
YES
NO
Set system to analog
308
LO=NOM-.1875MHz
310
NOMINAL
AFT == 00
NO
YES
312
LO=NOM-.1875MHz
314
AFT == 11
NO
YES
318
SYNC Detected
NO
YES
320
SIGNAL FOUND
322
Channel detected as an analog channel
208
300
Channel detected as an digital channel
204
316
AIR/CBL
CBL
AIR
324
HRC/IRC
Set system to digital
LO=HRC
326
Is channel digital?
Yes
NO
327
Set system to analog
328
LO=HRC+.1875MHz
330
AFT == 00
NO
YES
332
LO=HRC-.1875MHz
334
AFT == 11
NO
YES
338
336
CH. 5 or 6
NO
YES
Set system to digital
342
LO=IRC
344
Is channel digital?
345
Yes
No
Set system to analog
346
LO=IRC+.1875MHz
348
AFT == 00
NO
YES
350
LO=IRC-.1875MHz
352
AFT == 11
354
YES
NO
340
SYNC Detected
NO
YES
This channel number is neither an analog or digital channel
210

FIG. 4


400
Initialize failure timer for 2 seconds
402
LO = NOMINAL
404
Carrier Lock?
406
No
Yes
LO = NOMINAL + 62.5 KHz
410
Carrier Lock?
412
No
Yes
Init symbol timing
408
Segment Lock?
416
No
Yes
FEC Locked?
418
No
Yes
Read Solomon Error Rate OK?
420
No
Yes
Timer Expired?
422
No
Yes
Carrier Lock?
424
Yes
No
Channel is NOT Digital
414
Channel is Digital
424
Channel is NOT Digital
414

INTERNATIONAL SEARCH REPORT

Int. tional Application No
PCT/US 00/19059

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04N5/50

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

WPI Data, PAJ, EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	GB 2 325 805 A (DAE WOO ELECTRONICS CO LTD) 2 December 1998 (1998-12-02) the whole document ---	1,2,8,14
Y A	EP 0 574 273 A (TOSHIBA AVE KK ;TOKYO SHIBAURA ELECTRIC CO (JP)) 15 December 1993 (1993-12-15) column 7, line 54 -column 8, line 39 column 10, line 54 -column 11, line 54; figure 6 ---	1,2,8,14 3,15
A	EP 0 912 050 A (SAMSUNG ELECTRONICS CO LTD) 28 April 1999 (1999-04-28) column 4, line 26 -column 5, line 22 column 5, line 50 -column 6, line 45 --- -/--	1,6-8, 10,16

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 September 2000	02/10/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Fuchs, P

1

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 805 230 A (STARON ALAIN) 8 September 1998 (1998-09-08) column 1, line 49 -column 2, line 30 column 3, line 47 -column 5, line 65; figures 2,3	1,8,14
A	EP 0 766 462 A (SAMSUNG ELECTRONICS CO LTD) 2 April 1997 (1997-04-02) column 3, line 53 - line 47 column 14, line 10 - line 45; figures 1,2,5 column 16, line 5 - line 52; figure 8	1,8,14

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 00/19059

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
GB 2325805	A	02-12-1998	JP	10341176	A	22-12-1998
EP 0574273	A	15-12-1993	JP	5347736	A	27-12-1993
			CA	2098372	A	13-12-1993
			DE	69320868	D	15-10-1998
			DE	69320868	T	28-01-1999
			KR	9615838	B	21-11-1996
			US	5418815	A	23-05-1995
EP 0912050	A	28-04-1999	KR	222994	B	01-10-1999
US 5805230	A	08-09-1998	FR	2717026	A	08-09-1995
			EP	0696402	A	14-02-1996
			WO	9524098	A	08-09-1995
			JP	9501555	T	10-02-1997
EP 0766462	A	02-04-1997	CN	1151656	A	11-06-1997
			JP	9130697	A	16-05-1997
			KR	213048	B	02-08-1999
			US	6014178	A	11-01-2000
			US	5926228	A	20-07-1999